

# Installation of diverse sand/ZVI mixtures in the construction of Permeable Reactive Barriers

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## Background

The Kelly AFB project consisted of constructing a 650-foot Iron Filings Permeable Reactive Barrier (PRB) utilizing the biodegradable biopolymer slurry method of construction. The biopolymer slurry (Rantec G-150 with various types of preservatives) was utilized as a shoring fluid for deep trenching. The PRB was constructed along the northeast property of the former Kelly Air Force Base in San Antonio, Texas. The other project to be discussed (Goose Creek PRB) was located in Charleston, SC at the Naval Weapons Station. This project consisted of constructing a 130-foot long Iron Filings Permeable Reactive Barrier (PRB). Similar to the Kelly AFB project, the construction was performed utilizing Biodegradable Biopolymer Slurry.

## Materials and Methods

The Kelly AFB PRB was constructed to remediate groundwater impacted with chlorinated solvents. Contaminants of concern in the groundwater included Acetone, Chlorobenzene, Chloroform, 1,1-Dichloroethylene, Tetrachloroethylene and Trichloroethylene with concentrations ranging from 1 to 23 ug/l. The PRB had an average depth of 39-feet, a width of approximately 24-inches and a maximum depth of 43.5 feet, with a total facial area of 26,700 vertical square feet. The slurry trench was keyed 1-foot into the underlying Navarro clay. Slurry trenching was performed with a large modified extended-arm Hydraulic Excavator to facilitate the removal of hard consolidated seams of gravel and claystone overlying the Navarro clay layer. Slurry preparation was performed using a high-shear lightning batch plant. The backfill for the PRB included various blends of zero-valent iron and coarse sand. Placement of the treatment media backfill was done utilizing tremie pipes. Two mixtures of iron-sand treatment media were used based on contaminant concentrations along the proposed PRB's alignment. The first mixture consisted of a 50% to 50% (by volume) iron to sand blend. The second mixture was a 90% to 10% iron to sand blend. Treatment media was placed in the trench to within 1-foot above maximum historical water table elevation (Approximately 13 feet of treatment media thickness). The remaining upper portion of the PRB was backfilled with "flowable fill" sand to within 5 feet of the surface. A 5-foot clay cap was constructed over the "flowable fill" using on-site native soils.

The Goose Creek PRB was constructed at Solid Waste Management Unit 12 for the purpose of remediating impacted groundwater. Contaminants of concern in the groundwater included Vinyl Chloride; 1,1 Dichloroethene; 1,1 Dichloroethane; Cis 1,2 Dichloroethene; 1,2 Dichloroethene; 1,1,1-Trichloroethane; Trichloroethene and Tetrachloroethene with concentrations ranging from 2,200 ppb to 400,000 ppb. The constructed PRB had a depth ranging from 37 to 40 feet with a width of 36-inches. PRB construction was terminated upon keying 2.0-feet into an underlying clay confining layer. Slurry trenching was performed with a modified Extended-arm Hydraulic Excavator. Slurry preparation was performed using a high shear lightning slurry batch plant. The constructed PRB was backfilled with various mixtures of Zero-Valent Iron and sand. Placement of the treatment media backfill was done using Tremie pipes. Several mixtures of treatment media were used based on contaminant concentrations along the PRB's alignment. These mixtures consisted of the following blends;

- 20% to 80% (by weight) Zero Valent Iron to sand mixture. This blend was utilized to backfill a 40-foot and a 10-foot long segment of the trench.
- 50% to 50% (by weight) Zero Valent Iron to sand mixture. This blend was used in backfilling two, 20-foot long segments of the trench and the bottom 10-foot of an additional 40-foot segment.
- 100% Zero Valent Iron. This was utilized to backfill the upper portion of the 40-foot trench segment referenced above.

## Results

Upon the Kelly AFB PRB construction completion a liquid enzyme breaker (Rantec LEB-H) was introduced and circulated through the treatment media to degrade the slurry and develop the installed PRB. Liquid Enzyme Breaker was introduced and circulated through (4) "in-trench", 4-inch diameter monitoring wells which were placed in the excavated Slurry trench prior to backfilling.

The Goose Creek PRB construction completion used the same breaker technique by applying a liquid enzyme breaker and circulated through the treatment media. The completed PRB was capped using a combination of woven geotextile fabric and 2.5-feet of compacted clay.

Other aspects of work consisted of soil and surplus slurry profiling including on-site and off-site trucking for disposal. Work also included constructing a 30-foot wide work platform in-order to maintain a minimum of 5-feet of head differential between the trench slurry and groundwater.